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An International Study of the Cyclical Behavior of Labor Shares

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Abstract

This paper conducts an international investigation of the cyclical behavior of labor shares. Contrary to what many past studies have found for the behavior of labor shares, simple statistics and estimated VARs suggest that the labor share is not constant nor countercyclical, but behaves in a procyclical manner lagging both output and employment. Our findings are at odds with many models of the macroeconomy which assume or predict that the labor share is constant or countercyclical.

August, 1992

Keynes wrote in 1939, "The stability of the proportion of the national dividend accruing to labour is one of the most surprising, yet best established, facts in the whole range of economic statistics, both for Great Britain and for the United States." Following this statement, much theoretical work was devoted to explaining this observation. In 1958, however, Solow suggested that this "miracle" of constancy may be an optical illusion. For the U.S., he found that the labor share from 1929-1953 fluctuated as much if not more than its industrial components. Because of Solow's controversial findings, other studies were also directed at investigating the behavior of labor shares in the U.S. and other industrialized countries. These studies produced a collection of seemingly conflicting conclusions. In 1960, Hultgren conducted an investigation of the behavior of labor cost per unit of output in the U.S.. He found that from 1920-1955 labor shares were countercyclical for several manufacturing industries. In 1964, Lecaillion presented evidence that suggested that labor shares had no strong countercyclical behavior in Western Europe from 1939-1956. For the post-war period, 1948-1971, Sargent and Wallace (1974) also failed to find evidence that the labor share in the U.S. was countercyclical. More recently, however, Bils and Cho (1991) present evidence that the aggregate U.S. labor share has a countercyclical pattern in the post-war period, 1947-1988.

Because these investigations differ by the time periods studied, nations or industries considered, and/or the measure

used to evaluate the cyclical status of the economy, it is difficult to assess whether there are any stylized facts regarding the behavior of the labor share in decentralized market economies. In this paper we attempt to address this issue. By using annual data on the labor share and its components for 14 industrialized economies over the period 1960-1988, our analysis reveals two important facts about labor shares. First, contrary to Keynes, we find that the labor share is not constant in the short-run in any of the 14 countries considered. In fact, in 5 of the 14 economies considered, the labor share is more variable than output. And second, we find that the labor share is procyclical and lags output by at least one period in all 14 economies considered even though contemporaneous correlations would lead one to believe otherwise.

Together these findings challenge what many theoretical models of the macroeconomy assume or predict for the labor share. As for real business cycle (RBC) models, most assume that the labor share is constant over the business cycle.[1] On the other hand, Keynesian models with labor hoarding, neoclassical models with capital or labor adjustment costs, and models with production technologies which exhibit increasing returns to scale, often predict that labor shares move countercyclically. Given these two empirical facts alluded to above, none of the current paradigms provide a complete description of the cyclical

[1] A notable exception is Bils and Cho (1991) where the labor share is countercyclical.

behavior of the labor share.

The paper proceeds as follows: In section II, we describe the sources of the data and then visually examine it. In section III, we summarize the data by employing some simple statistics. Here we report means, standard deviations, and correlations between labor shares and it components for the 14 countries. We use Granger causality tests to investigate the temporal relationship between the labor share and output and the labor share and employment in section IV. In this section we also report impulse response functions from bivariate vector autoregressions (VARs) of output and the labor share and employment and the labor share in each country. We offer conclusions in section V.

II. The Data

We consider 3 variables sampled annually for 14 industrialized economies from 1960-1988. The countries studied are the United States (US), Canada (CA), Japan (JP), Germany (GR), France (FR), Italy (IT), United Kingdom (UK), Australia (AU), Netherlands (ND), Belgium (BE), Denmark (DN), Norway (NO), Sweden (SW) and Finland (FI). The variables we consider are the aggregate labor share (LS), real gross domestic product (Y), and employment (E). The labor share is defined as compensation over GDP minus indirect taxes. Compensation of employees consists of (a) wages and salaries in cash and kind, (b) employers' contributions to social security schemes and to private welfare

schemes for the account of their employees and (c) employers' contributions to private pension funds, life insurance, family allowances, health and other casualty insurance. Employment is total civilians employed in all activities. All variables are logged and we employ two popular detrending methods; first-differencing and H-P filtering due to Hodrick and Prescott (1980). All data are taken from OECD sources.

We plot the log differenced time series for real GDP and the labor share for each of the fourteen countries in figures 1a-1n.[2] One striking feature of all these figures is the apparent variability of the labor share. In many of the countries the labor share appears to be as variable as output. In most cases, these figures also reveal that the labor share is negatively related to output contemporaneously, but positively related to past output. In the U.S., as well as some of the other countries, the relationship with past output appears to be at lags between one and two years.

III. Summary Statistics and Correlations

In the previous section it was casually observed that the labor share fluctuates with the business cycle. In this section we examine the variability of labor shares in both the long and short-run. The labor share's mean growth rate and its mean growth rate relative to the growth rates of output and employment

[2] The corresponding figures using H-P filtered data reveal similar patterns.

are used as criteria to measure its variability in the long-run. For business cycle frequencies, the criteria employed is the labor share's standard deviation and its standard deviation relative to that of output's and employment's.

The labor share's mean growth rates and relative mean growth rates are given in table 1. In 13 of the 14 economies, the mean growth rate is 1% or less and its growth rate relative to that of output's ranges from 1.7% to 26.6%. However, the growth rate relative to that of employment's reveals a different picture. In the same 13 countries, these relative growth rates range from 3.5% to 301%. Hence, if compared to the variability of output, the common assumption made about the constancy of the labor share in models of long-run growth may be reasonable. However, if employment is predicted to vary in the long-run, this assumption appears less plausible at least for the sample period considered in this paper.

In table 1 we also report the labor shares' standard deviations and standard deviations relative to outputs' and employments'. By examining these results, it is immediately apparent that the labor share is also not constant in the short-run. As compared to outputs' standard deviations, the labor shares' relative standard deviations range from 46% in the US to 247% in Norway. And, as compared to employments' standard deviations, these relative standard deviations range from 79% in the US to 367% in Germany. Together, these observations demonstrate that the labor shares' short-run variability is a

noteworthy feature of the business cycle in industrialized economies. However, is its variation systematically related to output's or employment's?

Most RBC models assume that the labor share is constant and hence predict that there should be no systematic relationship between the labor share and output or employment. On the other hand, models with costs of adjusting labor or capital or models with true increasing returns predict an inverse relationship between the labor share and employment and the labor share and output. Models with labor adjustment costs predict an inverse relationship between the labor share and output or employment because firms choose to smooth labor input over the cycle and hence hoard labor in downturns ((Rosen (1968), Rotemberg and Summers (1988)). Models that incorporate capital adjustment costs, such as Bils and Cho (1991), predict an inverse relationship between the labor share and output or employment because of the complementarity that is assumed to exist between workers and capital. And in models with increasing returns to scale in production, as in Hall (1988) and Murphy, Shleifer, and Vishny (1989), the labor share is inversely related to output or employment because a change in output will be associated with a smaller change in compensation.

Table 2 reports the correlations between the labor share and output and the labor share and employment for both first-differenced and H-P filtered data. The presence of adjustment costs, bargaining behavior, or inflexible prices could cause the

relationship between these variables to be observed with a lead or lag. For these reasons, in addition to the contemporaneous relationships, we report correlations between each variable and one lag of the labor share and the labor share and one lag of each variable. In 10 of the 14 countries the labor share and output are negatively correlated contemporaneously. For first-differenced data (H-P filtered data), in 9 (12) of the fourteen cases the labor share at time t and output at time t+1 are also negatively related. However, for all of the differenced data and in all but one case using the H-P filtered data, the labor share and output lagged one period are positively related.[3]

The left hand panel of table 2 reports the correlations between employment and the labor share. As found in the correlations between the labor share and lagged output, the correlations between the labor share and lagged employment are primarily positive (positive relationships are found in 12 (11) of the fourteen cases using first-differenced data (H-P filtered data)). Contemporaneously, however, the relationships between the labor share and employment differ substantially from the relationships found between the labor share and output. The labor share is positively related to contemporaneous employment in 8 of the 14 countries using first-differenced data and in 10

[3] Our findings are consistent with the findings of Bils and Cho (1991) for the US using quarterly data. They report that the change in the labor share is negatively related to the change in current output. In the same regression equation, they also report that changes in the labor share are positively related to changes in output lagged one, two, and three quarters.

of the 14 countries using H-P filtered data.

Figure 2 plots the relationship between these contemporaneous correlations. As the plot illustrates, in the majority of cases the labor share and output are negatively correlated while the labor share and employment are positively related. Hence, the apparent discrepancy between Sargent and Wallace's finding of a positive relationship between the labor share and the business cycle and Bils and Cho's finding of an inverse relationship between the labor share and the cycle may be due to Sargent and Wallace's use of unemployment as a measure of the cycle and Bils and Cho's use of output.

In summary, for all of the countries considered, the information provided by the sample statistics indicate that the labor share significantly varies in both the short and long-run. Over the business cycle, the systematic relationships between the labor share and output and the labor share and employment, however, still remain unclear. We find that the labor share is positively correlated with contemporaneous employment, lagged output and lagged employment and negatively correlated with contemporaneous output, lead output and lead employment. Even though these results are robust to the detrending method employed, the fact that they vary depending on the timing of the relationship leads us to believe that the temporal relationship between these variables should be considered before a conclusion about the underlying relationships can be reached. In the next section we consider the temporal relationships between the labor

share and output and employment.

IV. Vector Autoregressions

Simple correlations are informative but they do not completely characterize the cyclical nature of the labor share. For this reason we use bivariate causality tests and impulse response functions from VARs to further investigate the relationships between first differences of the labor share and output in each country.[4] We begin by conducting Granger causality tests to examine whether or not there is a temporal relationship between the labor share and output and the labor share and employment in each country. Table 3 reports the results from these tests. The left hand panel reports the results from bivariate causality tests between the labor share and output. Columns 1 and 2 report the results for the test of output leading the labor share and columns 3 and 4 report the test results for the labor share leading output. We find strong evidence that output movements Granger cause labor share movements. The coefficients on lagged output in the labor share equations are significant at the 10% level of significance for 10 of the 14 countries. The exceptions are Canada, U.K., Australia, and Norway. However, none of the coefficients on lagged labor shares are significant in any of the output equations. These results support the hypothesis that the labor share lags output.

[4] The impressions are similar for the H-P filtered data. We chose to report VAR results only for the log differenced data in order to conserve space.

The left hand panel of table 3 reports the results from bivariate causality tests between the labor share and employment in each country. Columns 5 and 6 report the results for the test of employment leading the labor share and columns 7 and 8 report the test results for the labor share leading employment. The test results suggests that employment movements also Granger cause labor share movements. Lagged values of employment in the labor share equation are significant at the 10% level of significance for 9 of the 14 countries. The countries that are exceptions, however, differ from those found for the causality tests between the labor share and output above. There is no evidence of employment Granger causing the labor share in the U.S., Germany, Italy, Australia, and Norway. Nonetheless, here also none of the lagged values of the labor share are significant in any of the employment equations.

To further study the nature of these relationships we consider impulse response functions from bivariate VARs. Figures 3a through 3c graph the impulse response functions of labor share in each country from unit shocks to output in each country and figures 4a through 4c graph the same for unit shocks to employment.[5] The impulse response functions indicate a positive relationship between output and employment in each country and the labor share in each country. A positive, unit shock to

[5] Based on the results from the Granger causality tests, we chose to report this ordering.

output in each country is estimated to increase the labor share between .09 in France to .27 in Sweden at lag 1. This effect also appears to be persistent through out the 8 year horizon. At lag 8, the labor share is still positively affected by a unit shock to output at time period 1 in all economies. The impulse response functions in figures 4a-4c also indicate that a positive, unit shock to employment increases the labor share in all countries at lag 1. However, there are two notable differences between the effects on the labor share due to a unit shock to employment and output. First, the change in the labor share is on average far greater from a unit shock to employment than a unit shock to output. The range of the effect on the labor share from a unit shock to employment is from .15 for the U.S. and Norway to 1.05 for Sweden at lag 1. Second, for most countries, the effect on the labor share due to a unit shock to employment declines much more quickly than the effect from a unit shock to output.

V. Conclusions

The primary focus of the paper was on the variability of the labor share and its relationship to both output and employment over the business cycle. The information provided by the sample statistics indicate that the labor share significantly varies in both the short and long-run. Evidence of important temporal relationships between output and the labor share and employment and the labor share in all countries is also provided. We find

that output and/or employment Granger cause the labor share in most countries. What these results suggest is that the positive correlations between lagged output and the labor share and lagged employment and the labor share that we find in section III are the correlations of primary interest. The evidence from the impulse response functions is consistent with these positive correlations. Unanimously, the impulse response functions indicate that there is a positive relationship between movements in output and employment and movements in the labor shares. Overall, these temporal relationships in conjunction with the correlations given in section III support the notion that labor shares are procyclical but lag both output and employment.

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Table 1
Sample Moments

	MEANS					STANDARD DEVIATIONS				
	LS	Y	E	LS/Y	LS/E	LS	Y	E	LS/Y	LS/E
US	.0017	.032	.021	0.05	0.08	.011	.024	.014	0.46	0.79
						.013	.025	.014	0.52	0.93
CA	.0021	.044	.025	0.05	0.08	.016	.022	.016	0.73	1.00
						.015	.023	.019	0.65	0.80
JP	.0119	.061	.010	0.20	1.19	.026	.034	.007	0.77	3.71
						.036	.040	.007	0.90	5.14
GR	.0031	.029	.001	0.11	3.10	.015	.022	.017	0.68	0.88
						.017	.021	.020	0.81	0.85
FR	.0056	.036	.004	0.16	1.40	.015	.019	.007	0.79	2.14
						.020	.018	.008	1.11	2.50
IT	.0044	.038	.003	0.12	1.47	.024	.024	.009	1.00	2.67
						.024	.021	.010	1.14	2.40
UK	.0244	.024	.001	-1.02	-24.1	.022	.021	.016	1.05	1.38
						.021	.022	.019	0.95	1.11
AU	.0007	.041	.020	0.02	0.04	.029	.022	.016	1.32	1.81
						.025	.025	.020	1.00	1.25
ND	.0056	.033	.007	0.17	0.80	.021	.023	.010	0.91	2.10
						.022	.025	.013	0.88	1.69
BE	.0074	.032	.003	0.23	2.47	.017	.022	.010	0.72	1.70
						.023	.022	.013	1.05	1.77
DN	.0077	.029	.008	0.27	0.96	.019	.025	.015	0.76	1.27
						.017	.022	.011	0.77	1.55
NO	.0059	.040	.014	0.15	0.42	.037	.015	.013	2.47	2.85
						.049	.016	.016	3.06	3.06
SW	.0060	.028	.007	0.21	0.86	.024	.018	.008	1.33	3.00
						.026	.019	.009	1.37	2.89
FI	.0087	.036	.006	0.24	1.45	.028	.023	.016	1.22	1.75
						.026	.027	.016	0.96	1.63

The variables LS, Y, and E denote labor share, output, and employment respectively. The first row reports the results for first-differenced data and the second row reports the results for H-P filtered data.

Table 2
Correlations with the Labor Share

	LS-Y(-1)	LS-Y	LS-Y(+1)	LS-E(-1)	LS-E	LS-E(+1)
US	.417	-.365	-.311	.340	-.020	-.462
	.295	-.205	-.374	.174	-.184	-.501
CA	.430	-.280	-.156	.581	-.187	-.451
	.321	-.096	-.106	.387	-.108	-.340
JP	.148	-.406	-.126	-.174	-.471	-.502
	-.148	-.534	-.646	-.422	-.734	-.747
GR	.781	.219	-.134	.616	.319	-.208
	.728	.335	-.091	.716	.440	-.096
FR	.309	.000	.183	.439	-.043	.103
	.027	-.210	-.319	.598	.227	.064
IT	.490	-.254	.044	.094	-.236	.331
	.352	-.211	-.234	-.348	-.389	-.356
UK	.370	-.478	-.424	.565	.104	-.340
	.357	-.318	-.499	.596	.249	-.224
AU	.470	-.402	-.123	.325	.439	-.486
	.314	-.236	-.297	.445	.221	-.392
ND	.604	.247	.392	.274	.223	-.044
	.706	.470	.331	-.020	.025	-.087
BE	.515	.233	.244	.624	.180	-.184
	.495	.209	-.026	.510	.124	.281
DN	.331	-.416	-.190	.284	-.011	.031
	.335	-.219	-.245	.372	.180	-.005
NO	.125	-.040	.098	-.058	.144	.235
	.178	.270	.320	.011	.302	.412
SW	.446	-.253	-.073	.487	.119	-.363
	.134	-.289	-.361	.651	.424	.123
FI	.391	-.251	-.255	.380	.101	.015
	.331	-.236	-.431	.629	.378	-.068

See notes under table 1. The correlations are between labor share and output. Y(-1), Y, and Y(+1) denote output lagged one period, contemporaneous output, and output one period ahead of the current period respectively.

Table 3
Granger Causality Tests

	Labor Shares and Output				Labor Shares and Employment			
	F_y	P-value	F_{LS}	P-value	F_{EMP}	P-value	F_{LS}	P-value
US	3.89	0.06	-7.75	1.00	1.94	0.18	-8.64	1.00
CA	2.67	0.12	-9.20	1.00	3.92	0.06	-10.42	1.00
JP	7.41	0.01	-11.05	1.00	3.02	0.10	-3.47	1.00
GR	12.86	0.00	-5.43	1.00	1.66	0.21	-0.05	1.00
FR	3.90	0.06	-14.52	1.00	7.56	0.01	-4.13	1.00
IT	4.06	0.06	-4.32	1.00	0.24	0.63	-0.98	1.00
UK	-0.24	1.00	-5.81	1.00	7.56	0.01	5.89	0.03
AU	1.46	0.24	-6.74	1.00	0.82	0.38	0.54	0.47
ND	9.04	0.01	-4.19	1.00	4.43	0.05	-6.14	1.00
BE	11.93	0.00	-7.09	1.00	24.92	0.00	-4.23	1.00
DN	7.47	0.01	-1.84	1.00	4.72	0.04	-1.85	1.00
NO	1.15	0.30	-5.94	1.00	-0.27	1.00	0.36	0.55
SW	5.47	0.03	-10.49	1.00	9.11	0.01	0.71	0.41
FI	5.60	0.03	-4.30	1.00	3.50	0.08	1.39	0.25

On the left-hand-side of the table F_y is the statistic that tests the temporal relationship of output leading the labor share. F_{LS} tests the converse. On the right-hand-side the statistics can be interpreted in the same manner. Asymptotically, all statistics follow an F-distribution.

Figure 1a: Labor Share and Output for the U.S.

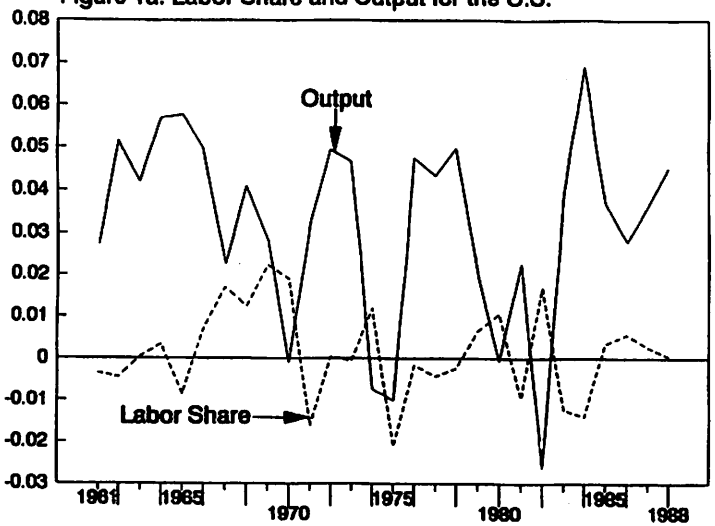

Figure 1b: Labor Share and Output for Canada

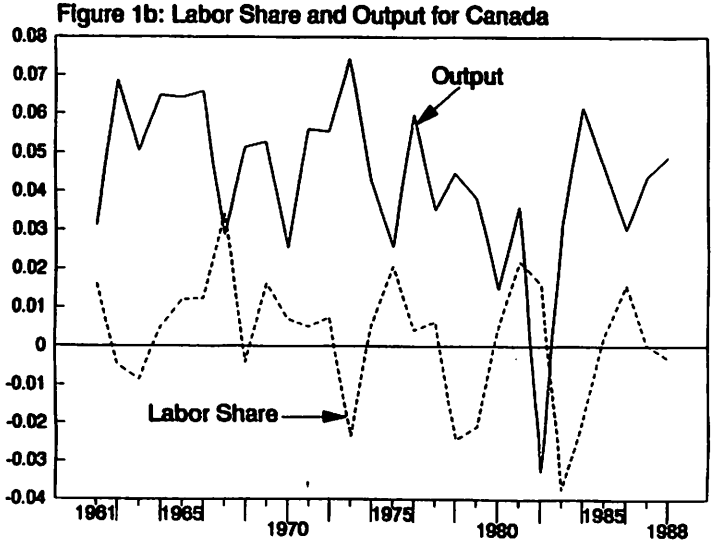

Figure 1c: Labor Share and Output for Japan

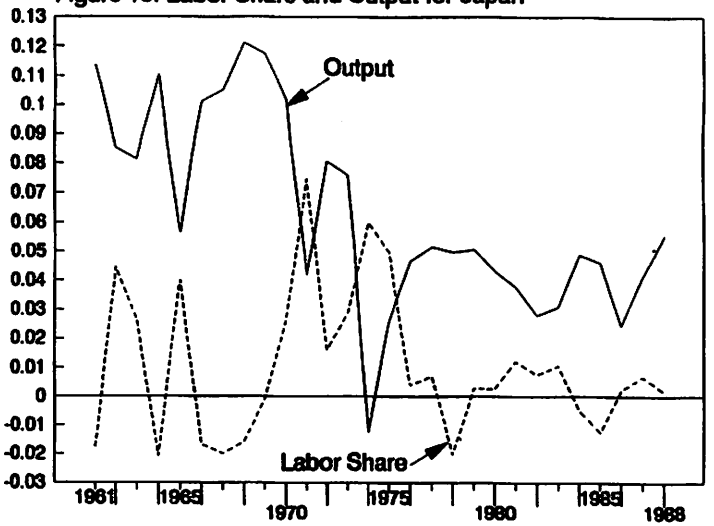

Figure 1d: Labor Share and Output for Germany

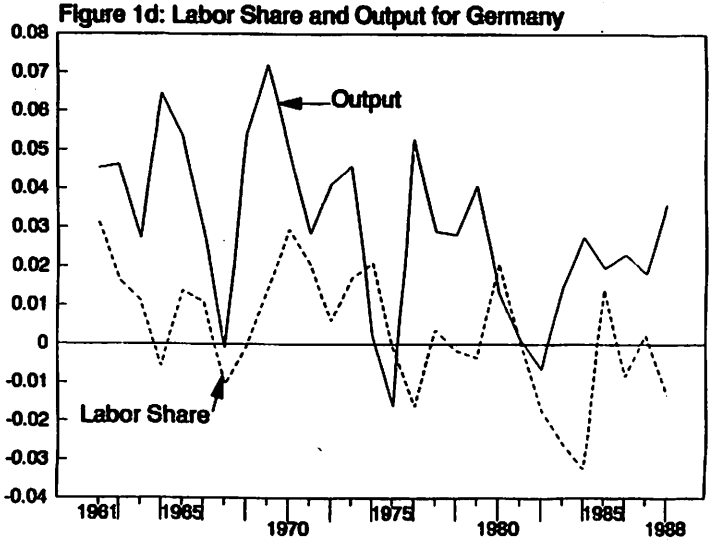

Figure 1e: Labor Share and Output for France

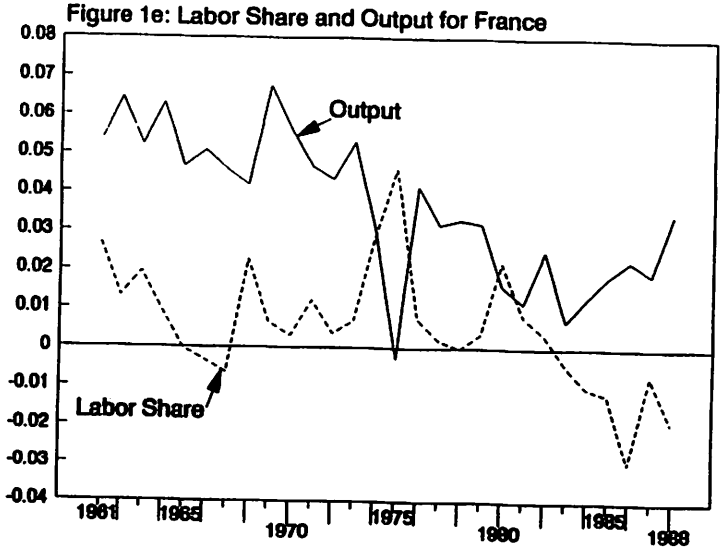

Figure 1g: Labor Share and Output for the U.K.

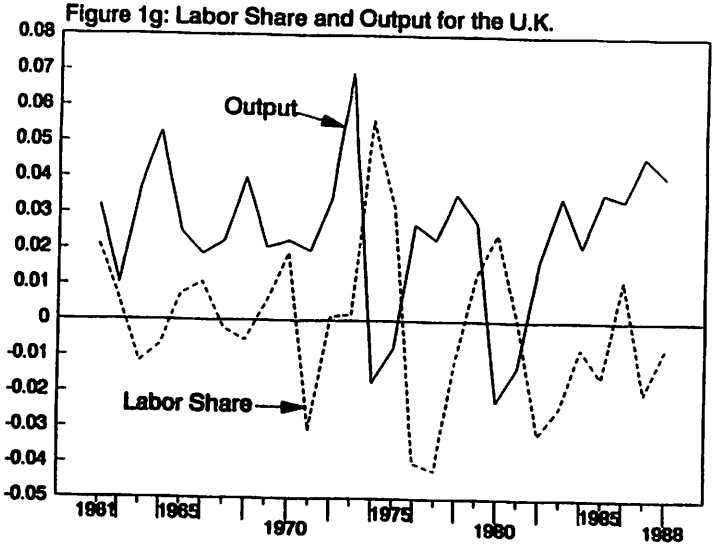

Figure 1f: Labor Share and Output for Italy

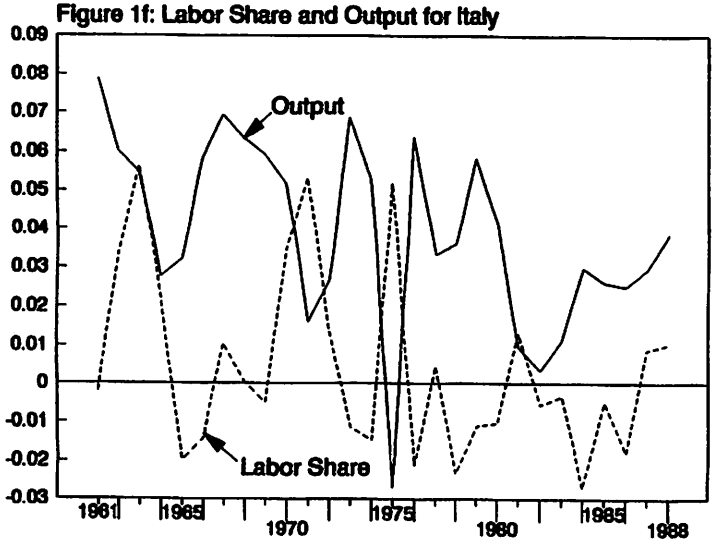

Figure 1h: Labor Share and Output for Australia

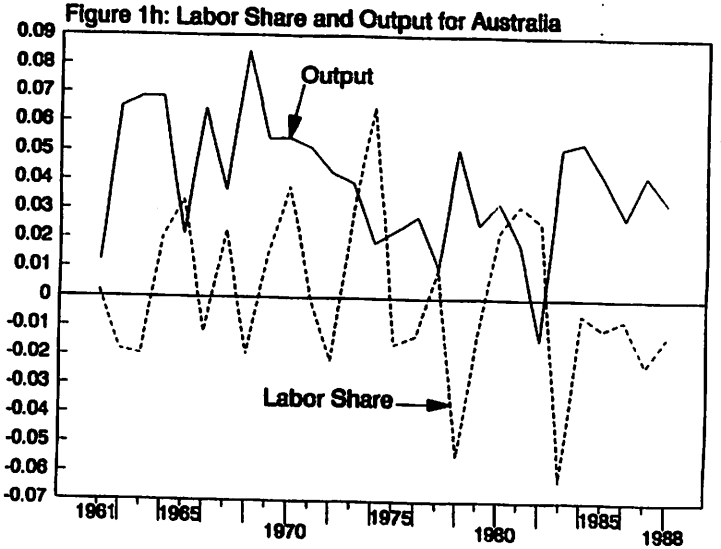

Figure 1i: Labor Share and Output for the Netherlands

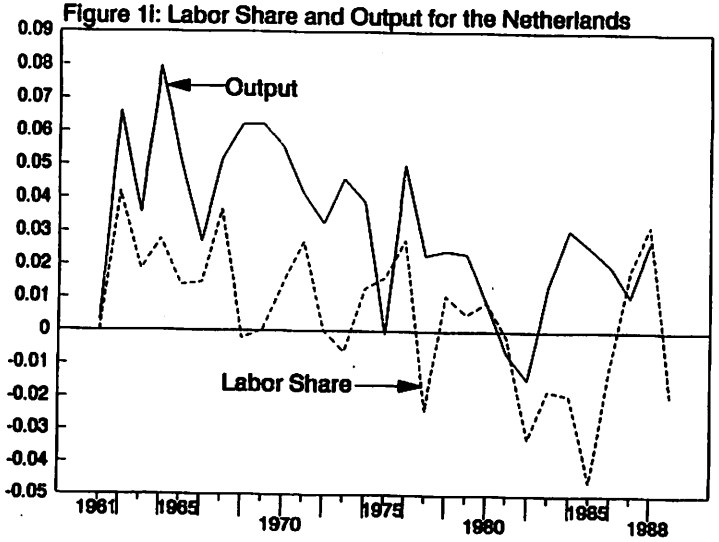

Figure 1k: Labor Share and Output for Denmark

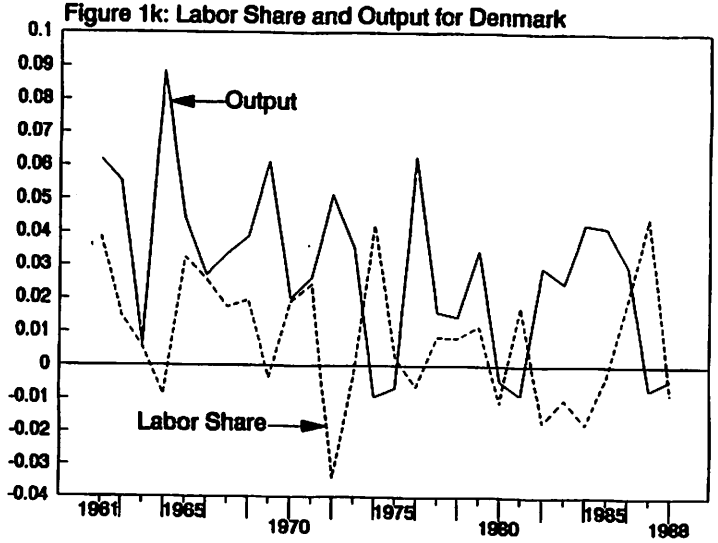

Figure 1j: Labor Share and Output for Belgium

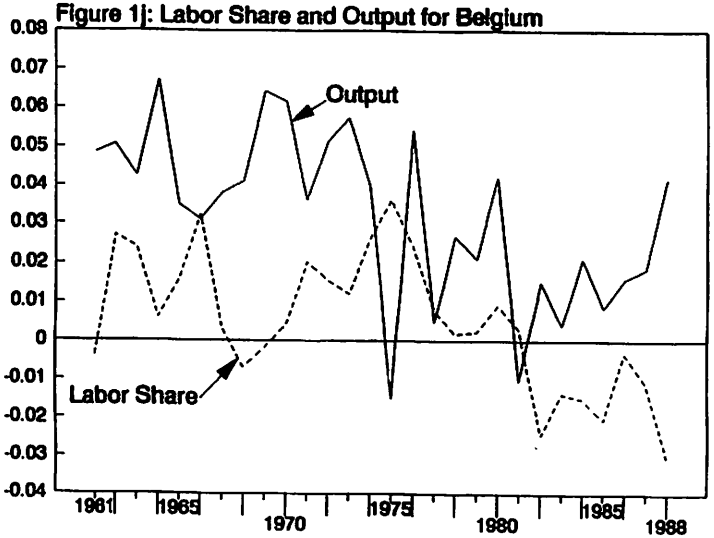

Figure 1l: Labor Share and Output for Norway

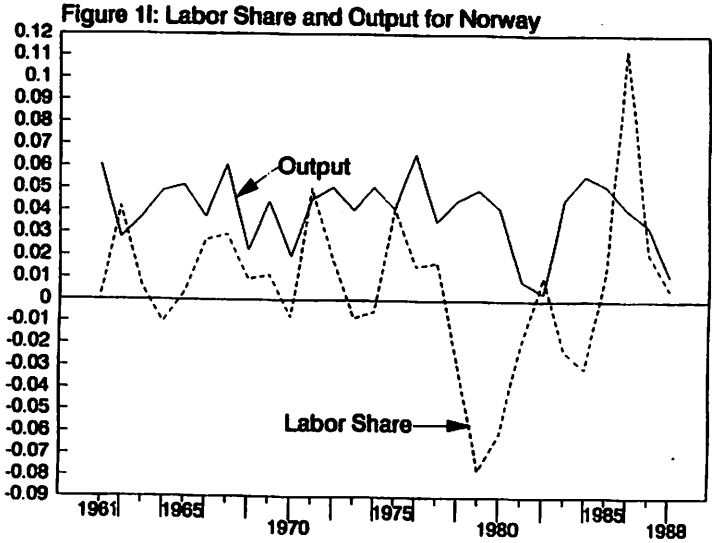

Figure 1m: Labor Share and Output for Sweden

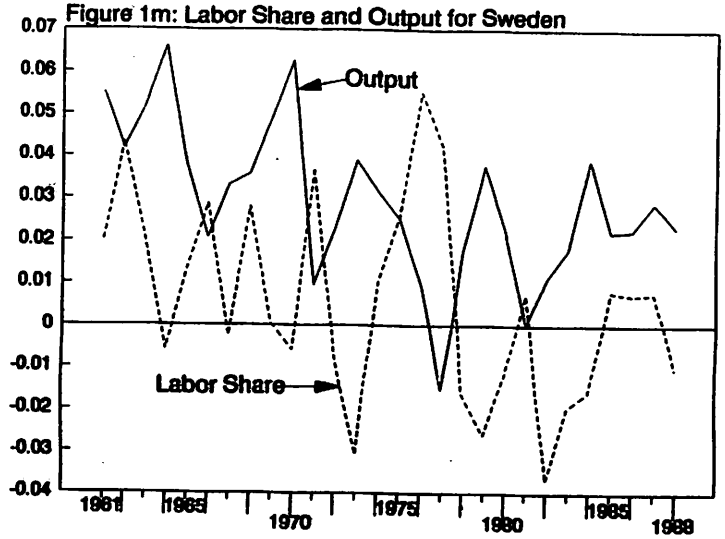

Figure 1n: Labor Share and Output for Finland

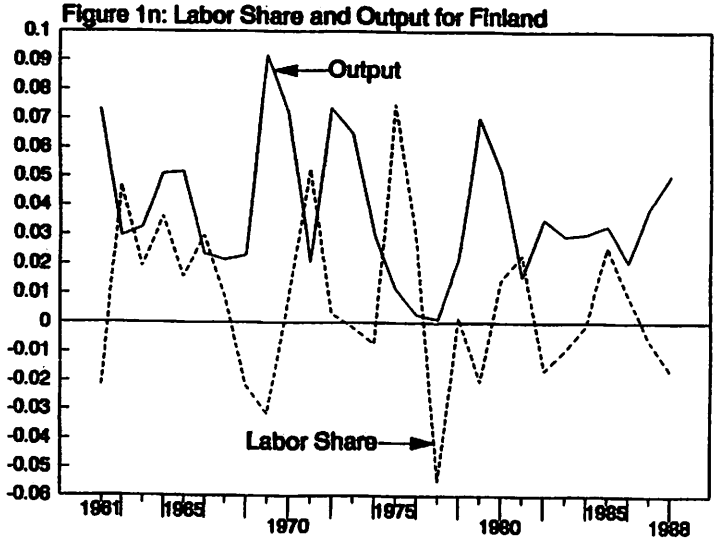

Figure 2: Correlations
Labor Share-Output (LS-Y) and Labor Share-Employment (LS-E)

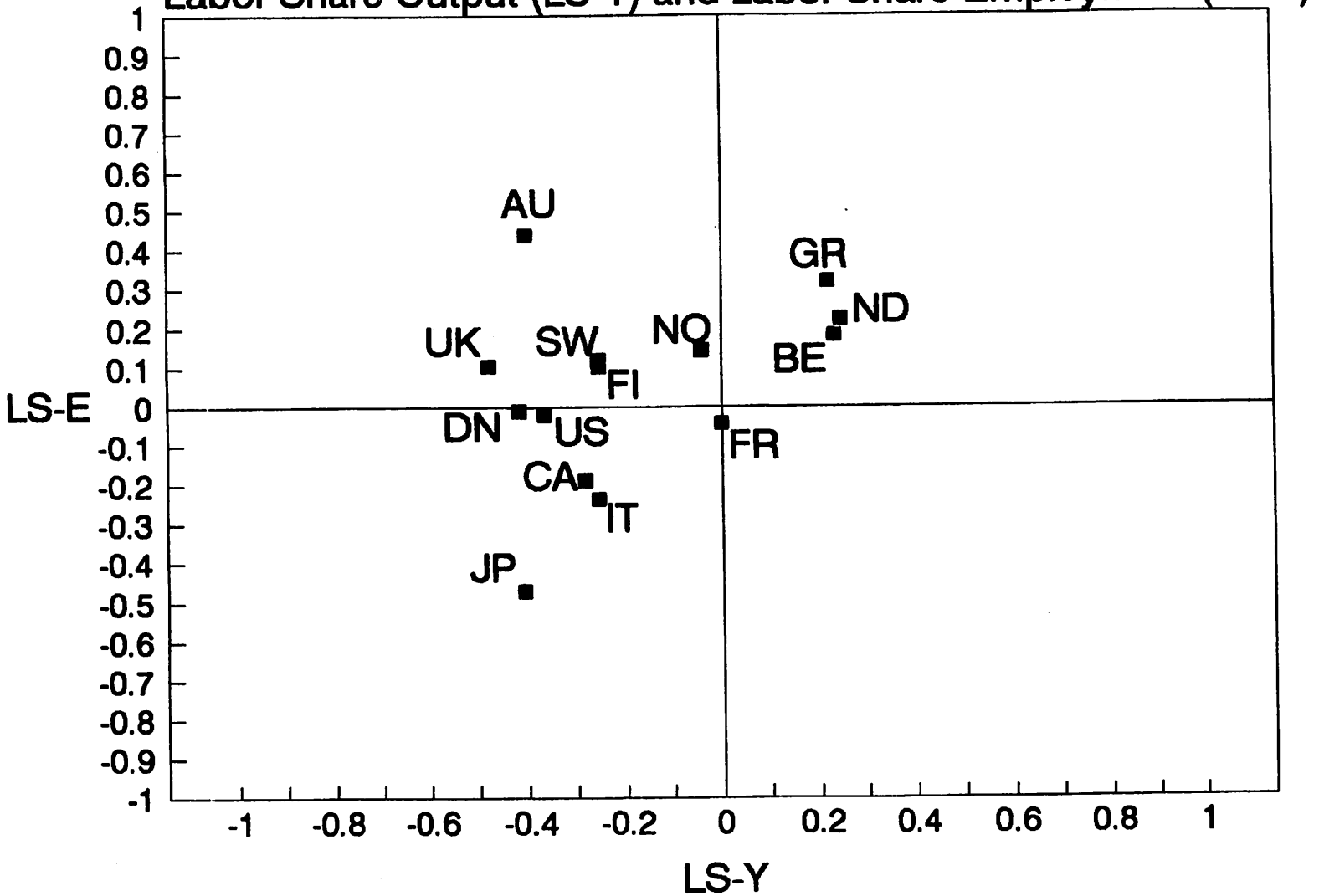

Figure 3a: Impulse Response of the Labor Share to a Unit Shock to Output
U.S., Canada, Japan, Germany, France, Italy

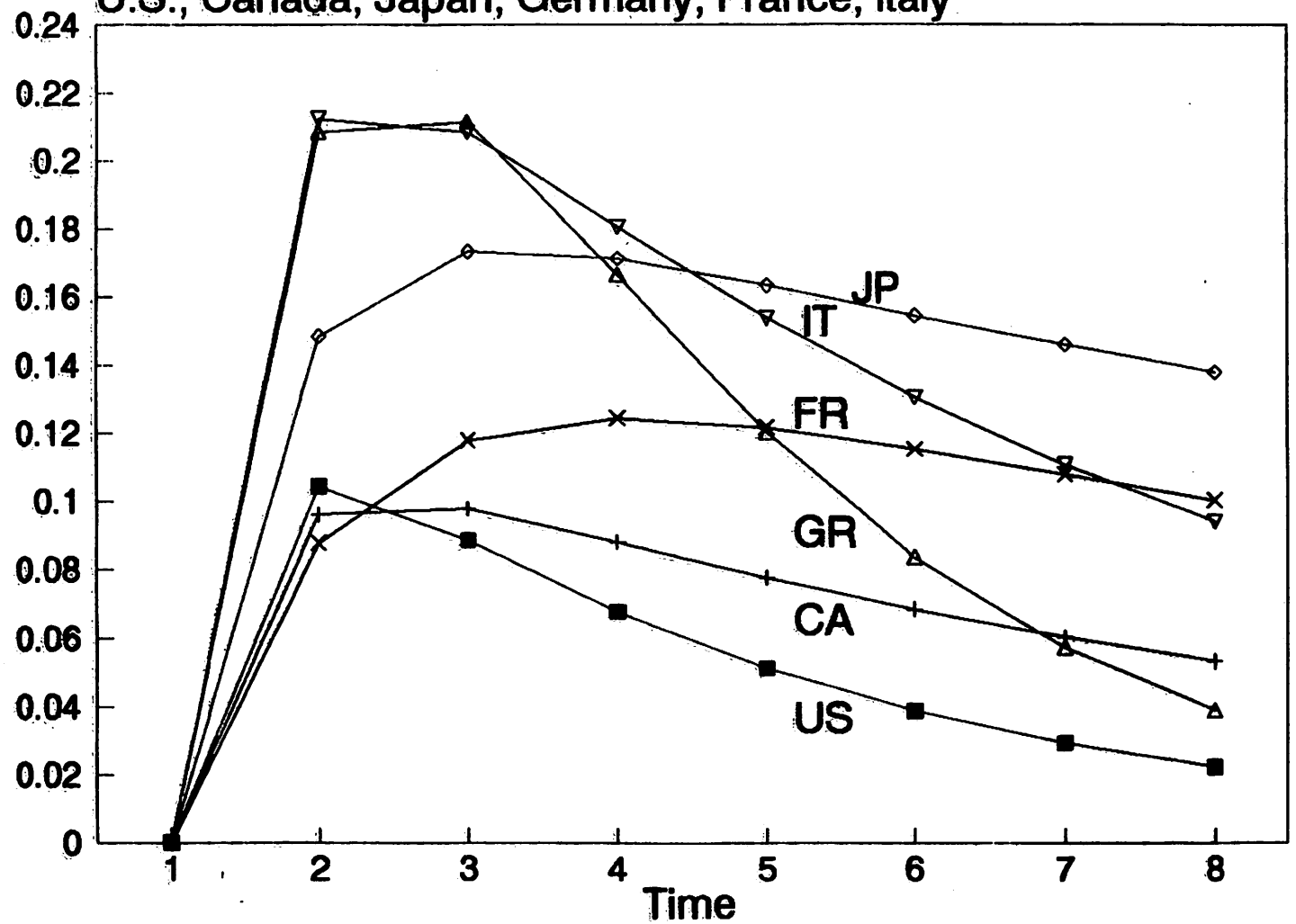

Figure 3b: Impulse Response of the Labor Share to a Unit Shock to Output
U.S., U.K., Australia, the Netherlands, Belgium, Denmark

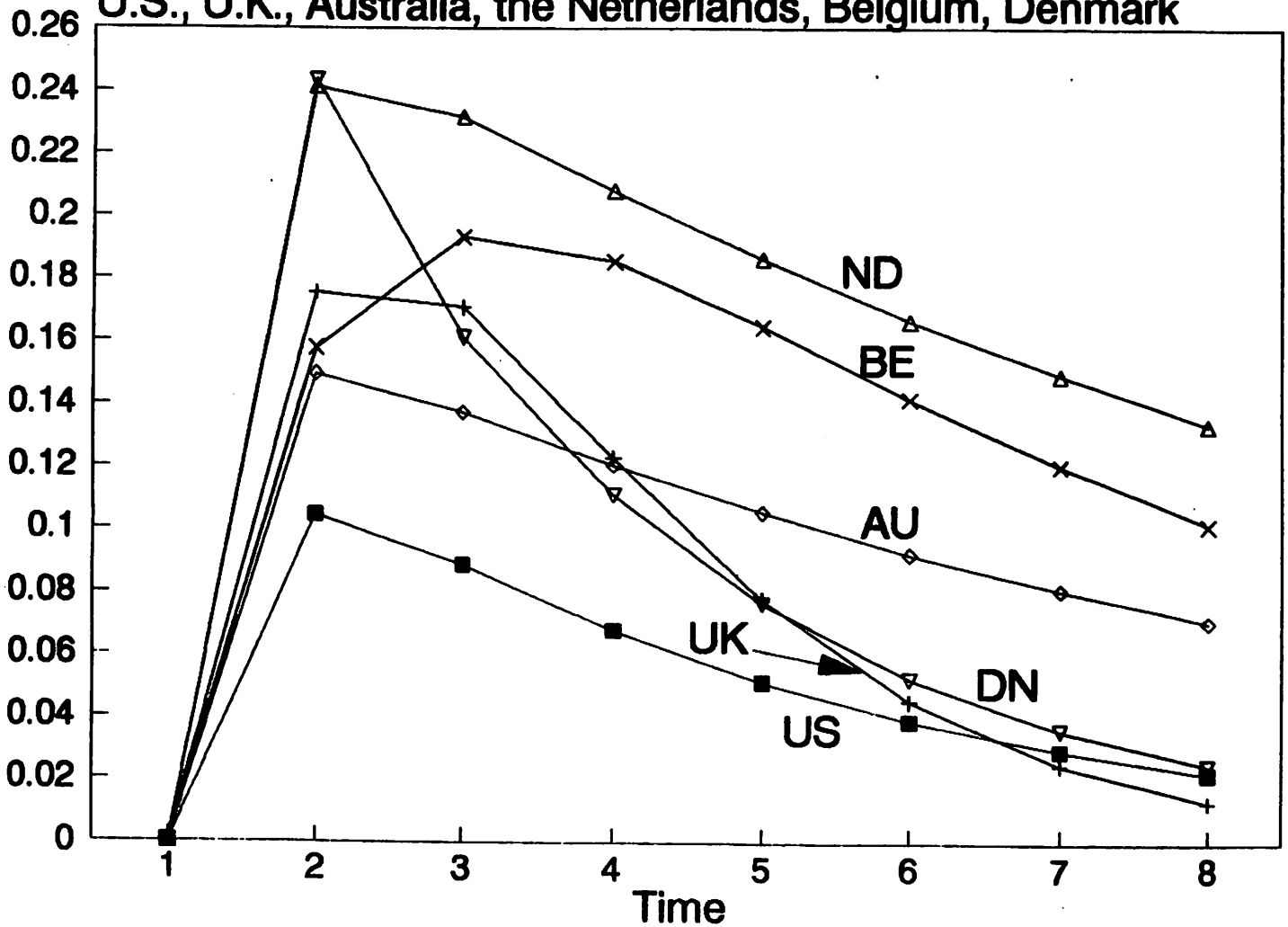

Figure 3c: Impulse Response of the Labor Share to a Unit Shock to Output
U.S., Norway, Sweden, Finland

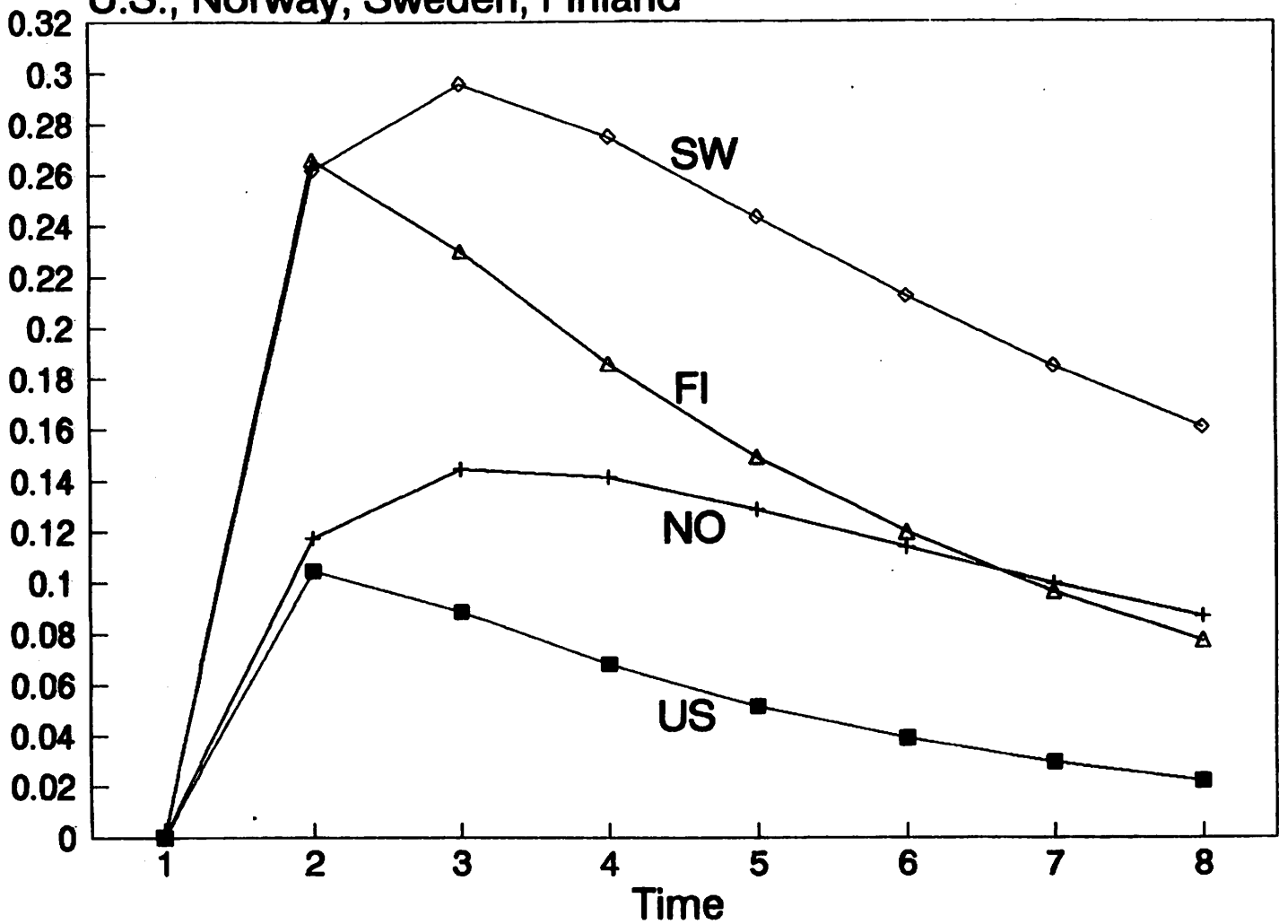

Figure 4a: Impulse Response of the Labor Share to a Unit Shock to Employment
U.S., Canada, Japan, Germany, France, Italy

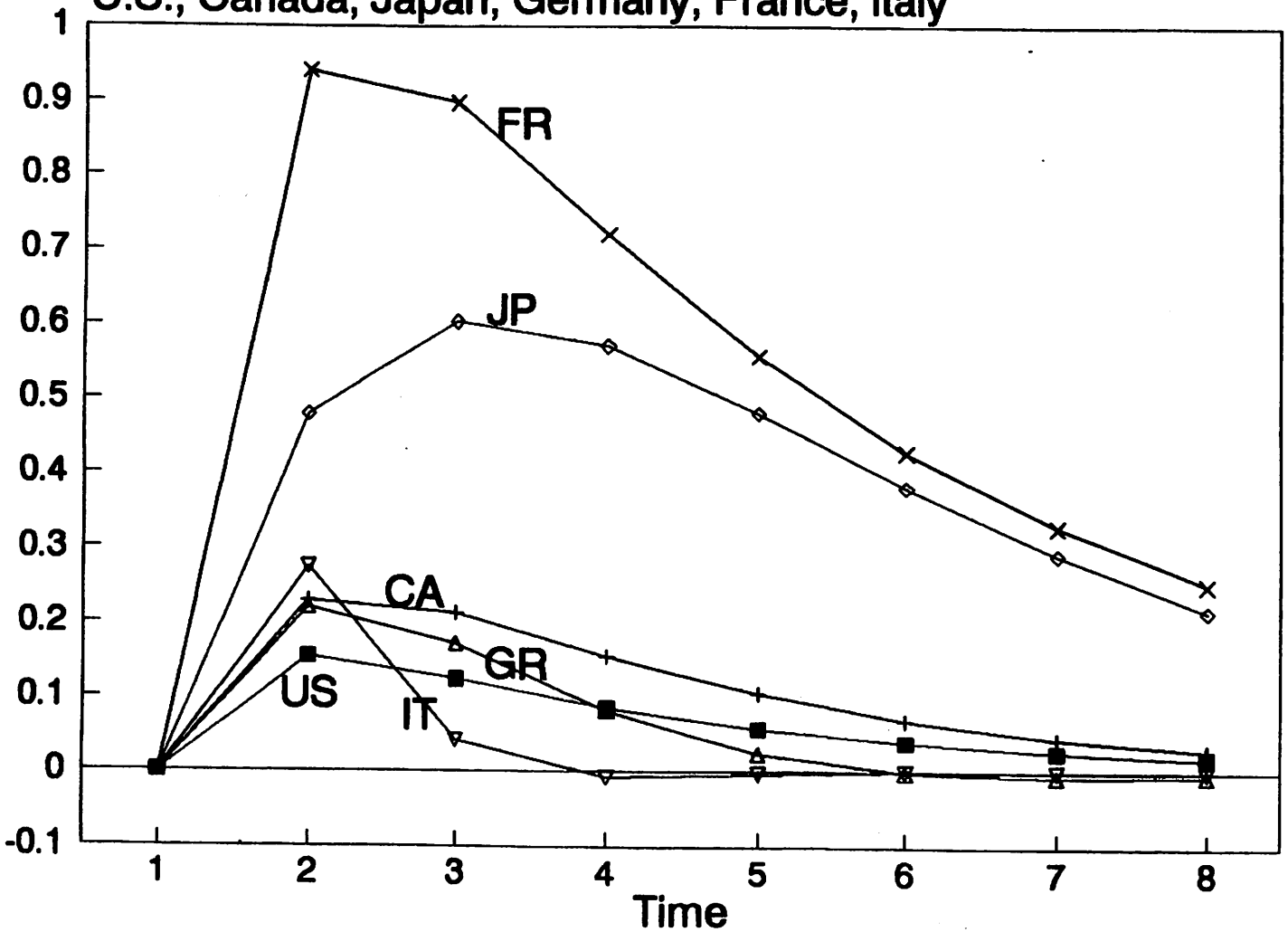

Figure 4b: Impulse Response of the Labor Share to a Unit Shock to Employment
U.S., U.K., Australia, the Netherlands, Belgium, Denmark

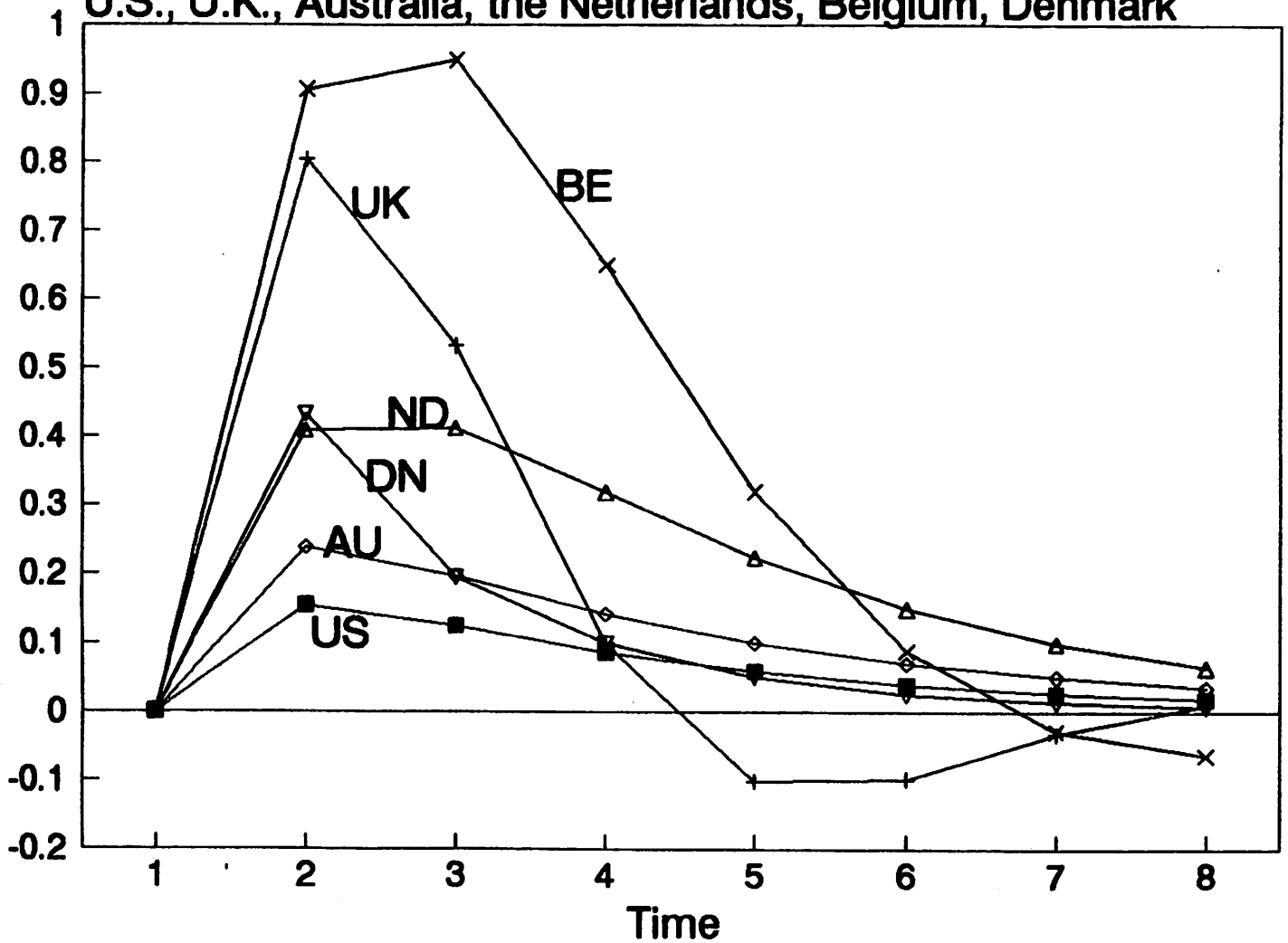

Figure 4c: Impulse Response of the Labor Share to a Unit Shock to Employment
U.S., Norway, Sweden, Finland